MEMORANDUM

TO: David M. Morris, Director
Office of Management and Budget

DATE: May 23, 2001

FROM: Corinne Brody, Director
Office of Performance Improvement

SUBJECT: Analysis of Alternatives for Tree Maintenance by the Public Works Department

SUMMARY

The Office of Performance Improvement (OPI) reviewed the Public Works Department's Tree Health Program, to determine the most effective alternative for watering, fertilizing and other selected maintenance of approximately 80,000 trees along County rights-of-way. Based on limited private sector comparative data, we believe that the current program is cost competitive. However, we recommend the Department develop an accurate tree inventory, review its tree maintenance policies and maintain up-to-date maintenance records in order to develop workload measures. Until better workload information is developed and a more accurate cost analysis completed, OPI recommends increasing field staff to 10 on an interim basis and purchasing two additional water trucks.

The Right-of-Way Aesthetics and Assets Management (RAAM) Division manages the Tree Health Program (Program) that includes watering, fertilizing, resetting and removing trees along County rights-of-way. In FY 1999-00 RAAM operated with two full time employees, one water truck (a second water truck is on order), and a budget of $250,000. Due to funding limitations, efforts have been concentrated in the areas of highest need or where there are citizen complaints. Based on our review of maintenance logs, which did not provide a complete inventory of maintenance work performed, we estimate that staff can perform approximately 13,000 tree fertilizations annually (including the accompanying water application) at a cost of approximately $6.00 to $9.00 per application. During the FY 2000-01 budget process, the Division received $1,047,000, an increase of $797,000 over the previous annual amount, to significantly expand the Program.

OPI examined four alternatives (Table 1) for expanding the Tree Health Program: a comprehensive program to maintain all 80,000 trees; an expanded program proposed by RAAM; a program based on landscaping practices recommended by the University of Florida Institute of Food and Agricultural Sciences Cooperative Extension Service (Cooperative Extension); and private proposals for maintaining all 80,000 trees.

A comprehensive program staffed by County employees would cost approximately $2.95 million per year and require 42 field operators and three supervisors. This option would also require a fleet of 32 water trucks or equivalent rental capacity to complete the required watering. Under this program, it would cost $3.51 per fertilizer application and $1.84 per water application.

RAAM has proposed expanding the existing Program by purchasing two additional water trucks, hiring 8 additional operators and a full time supervisor. Under this program RAAM would fertilize year round and complete additional watering during the dry season. The Division could fertilize approximately 50,400 trees twice per year at a cost of $4.03 per application and water 12,000 trees at $1.84 per water application. The total cost for the year would be approximately $800,000.

The Cooperative Extension program assumes the same staffing as the RAAM proposal but recommends no fertilization during the colder months of December and January. This option allows the County to fertilize 48,600 trees twice per year and water 12,000 trees 12 times per year. In both programs, the number of water trucks limits the capacity to water additional trees.

Table 1
Tree Health Program
Fertilization and Watering Cost Comparisons

Maintenance Program Options	Program Cost[1]	Cost/Fertilizer Application	Cost/Water Application	Cost/ Fertilizer Application with Water	Field Staff (Supervisors)	Equivalent Trees[2]
Current Program (FY 1999-00)	$174,783	$6.74 $3.52[3]	$2.40	$9.14 $5.92[3]	2 (<1)	F: 6,540 or 13,000[3] W: 1,574
Comprehensive Program	$2,946,228	$3.51	$1.84	$5.35	42 (3)	F: 86,400 W: 80,000
RAAM-Proposed	$809,204	$4.03	$1.84	$5.87	10 (1)	F: 50,400 W: 12,000
Alternate Program – Proposed[4]	$794,885	$3.89	$1.84	$5.73	10 (1)	F: 48,600 W: 12,000
Private Provider 1		N/A	N/A	$6.57	(TBD)[5]	
Private Provider 2		N/A	N/A	$10.00	(TBD)[5]	
Private Provider 3		N/A	N/A	$10.00	(TBD)[5]	

Notes
1. Includes cost of watering, fertilizing, resetting, removal and special treatments. Current program costs also include mulching and pruning.
2. "F" represents the equivalent number of trees fertilized twice per year and "W " the number of trees watered 12 times per year.
3. $6.74 is based on the maintenance log. Based on the quantity of fertilizer purchased during FY-00 the cost per application is $3.52.
4. Based on accepted practices provided by Cooperative Extension.
5. Under a private provider option some level of supervision would need to be determined.

Based on informal private provider price quotes, we believe that RAAM is cost competitive and, consequently, do not recommend outsourcing the current or expanded Program at is time. Private provider costs per fertilizer application (excluding County contract monitoring and additional dry season watering costs) are higher than the Department's and range from $6.57 to $10.00. Additionally we estimate it would cost the County between $0.82/tree (one inspector) and $3.28/tree (four inspectors) to supervise private contracts.

OPI recommends a series of improvements to the current Program, including a moderate increase in staff and capital pending the development of refined policy and annual workload estimates. First, RAAM should conduct a tree inventory (possibly using temporary staff or summer interns). The inventory should include information for developing a maintenance program such as tree location, species, age and condition. Additionally, RAAM should identify established trees in favorable locations that do not require regular maintenance. Based on this inventory, RAAM should develop a more appropriate tree maintenance policy. The resulting schedule should then be used to more accurately determine appropriate staffing levels and equipment needs. RAAM should also consider creating geographically based teams and maintain detailed maintenance logs. This would increase the employees' ability to provide consistent service within zones and ensure all regions of the County receive attention.

As an interim measure, OPI recommends RAAM increase field staff to ten operators, employ a full time supervisor and purchase two additional water trucks. Total incremental costs would be approximately $614,000 excluding the cost of the water truck currently on order. When circumstances require additional temporary capacity, the Division may rent equipment and/or hire temporary personnel.

For future tree plantings (new and replacement trees), the County should revisit past practice of planting non-indigenous species that require additional care and maintenance. Trees that are adaptable to dry soil conditions, suitable for roadside use, and with a high tolerance to salt should be considered. The County may also wish to consider alternative tree health strategies including requiring property owners to maintain trees on their easements, "adopt-a-tree" or "adopt-a-median" programs[1] (in conjunction with the current "Shade for Dade" program coordinated by the Department of Environmental Resources Management). Additional support may also be available through the County's corporate sponsorship program. All these initiatives will contribute to reducing the County's tree maintenance workload.

[1] Florida jurisdictions with adopt-a-median programs include the City of Cape Canaveral and Brevard and Flagler Counties.

BACKGROUND

In 1994, the County initiated a roadway beautification program as part of preparations for the upcoming Summit of the Americas and in response to extensive loss of tree canopy following Hurricane Andrew in 1992. The beautification program initially focused on planting approximately 80,000 trees representing 54 different species along County rights-of-way[2]. The County subsequently began to address the need for regular tree maintenance and in 1998, the Public Works Department (PWD) and the Park and Recreation Department (Parks) jointly prepared a Landscape Maintenance Master Plan outlining current, enhanced and comprehensive levels of landscape maintenance services.

During the five-year period ending in FY 1999-00, the operating budget for the Tree Health Program in RAAM was limited to $250,000 per year, only allowing for maintenance of approximately 12% of the 80,000 trees. Recognizing the need for increased tree maintenance, the County approved a $797,000 budget increase for a total allocation of $1,047,000 for the FY 2000-01. Subsequently, OPI was requested to review the Tree Health Program and recommend a method for expanding maintenance, considering the options of using additional in-house resources or contracting with private providers.

Under the Tree Health Program RAAM is responsible for watering, fertilizing and general maintenance of all 80,000 trees. Many trees are planted in restrictive environments, such as medians, where the soil may neither be rich in minerals nor retain much moisture. Others are susceptible to drought and drought-like conditions created as a result of heat reflected off of pavement and emitted in vehicle exhaust. Some species are also susceptible to disease; in particular, many of the County's coconut palms have recently been affected by lethal yellowing. In addition to watering and fertilizing, RAAM resets trees that have been uprooted by wind, vandalism or vehicle accidents; removes trees that are diseased or damaged; removes berm and performs soil fill as needed. RAAM does not maintain trees in County parks, along the County Greenway, or those trees planted as part of the County's "Shade for Dade" program. The Division also performs special maintenance such as mulching and also responds to complaints from elected officials and citizens.

OPI contacted the University of Florida Institute of Food and Agricultural Sciences Cooperative Extension Service (Cooperative Extension) for recommendations regarding tree maintenance. Cooperative Extension states that trees located in restricted areas such as medians can never be considered "established" and will require permanent, regular maintenance. Trees in more hospitable sites, such as roadsides, may be considered established after three years, depending on the species. Most non-palms species, as well as many palm species (including royal and sabal palms) fall into this category. Some palms, including the coconut and phoenix palms, require permanent maintenance regardless of where they are planted.

[2] Parks data show a total of 76,837 trees were planted between 1994 and 1999. Actual tree count varies as new trees are planted while others are removed due to disease or damage. Total tree count includes trees planted by the Florida Department of Transportation and maintained by the County. RAAM has inventoried a total of 48,437 trees Countywide of which 35,175 are palms.

Cooperative Extension recommends fertilizing trees four times per year using 1.5 pounds per 100 square feet of canopy broadcast throughout the drip line. Fertilizer may be applied year round, except during the cold months of December and January. If resources permit only two annual applications of fertilizer, the preferred months are May and September and the rate of application should be increased from 1.5 pounds per 100 square feet of canopy. Cooperative Extension also recommends using slow-release "improved palm special" fertilizer and applying water following each fertilizer application. In addition, trees require watering during the dry season (mid-October to mid-May).

OPI reviewed the current and proposed tree health programs, estimated the respective costs and examined several initial price quotes by private firms. Additionally, OPI conducted a survey of tree maintenance practices in six local jurisdictions, including the County's Park and Recreation Department.

FINDINGS

Current Service Levels

The Tree Health Program has a staff of two full time automotive equipment operators, a Public Works Supervisor and a Division Superintendent. The supervisor and superintendent devote approximately 15% and 5% of their time, respectively, to the Program. Headquartered on the Rickenbacker Causeway in Key Biscayne, the staff uses two pick-up trucks and a water truck. RAAM has ordered a second water truck for delivery this year. Given the large number of trees, as well as its limited staffing and other resource constraints, the Division has not been able to water and fertilize all 80,000 trees. Consequently, the Division focuses on major thoroughfares and responds to complaints made by citizen and elected officials on an as-needed basis.

RAAM maintains a partial inventory of trees, grouped by stretch of road, and a maintenance logbook detailing work completed. The log is incomplete and continues to be a work in progress as many trees have not yet been counted, nor has all tree maintenance activity been updated in the log. For example, according to the log, no trees were reset in October or November 1999; however, in the aftermath of Hurricane Irene, RAAM concentrated predominantly on resetting trees. Nevertheless, the log remains the Division's primary source of data regarding tree maintenance activities.

Tree Watering

Very few County rights-of-way are irrigated, primarily due to the high cost of installing and maintaining irrigation systems. RAAM strives to complete 12 annual watering cycles during the dry season, using approximately 20 to 30 gallons of water per application. This assumes there are no watering restrictions imposed in the dry season. Generally, watering activity depends on precipitation levels and on the need to water recently fertilized trees within days of the fertilizer application. The Division estimates that each employee can water an average of 200 trees per day. Employees completed 18,888 water applications over 49 days between October 1999 and September 2000 at a cost of $2.40 per water application (Table 2). This is equivalent to watering approximately 24% of the 80,000 trees once, or 2% of the trees 12 times per year. However, the actual number of water applications may be higher, as the log

is incomplete. Watering was heaviest in November, when workers reset numerous trees that had been felled by Hurricane Irene on October 15, 1999.[3] No watering was done during the rainy months (July, August and September).

Fertilization

The seventeen species of palms are treated with 12-04-12[4] granular "palm special" fertilizer while the remaining 37 species are treated with 12-06-08 granular fertilizer.[5] Palms that appear to be diseased were treated with a mixture of Epson salt and magnesium sulfate. Staff uses pre-measured scoops to manually apply five pounds of fertilizer along the drip line of each tree. Each employee can fertilize approximately 100 trees per day, including driving time, administrative duties and breaks. Each fertilizer application must be accompanied by a water application within a few days, unless it rains.

Both PWD and Parks concur that, ideally, trees should be fertilized four times per year; twice during the growing season, once in the spring and once in the fall. Given the limited staff, RAAM attempts to fertilize trees twice per year, however, the Division is unable to fertilize all 80,000 trees. In an effort to treat the maximum number of trees, RAAM fertilizes year-round using slow-release fertilizer that, theoretically, remains in the soil for extended periods of time until activated by rain or manual watering. Fertilization activity is heaviest during rainy months, when less watering is required.

According to the maintenance log, from October 1999 through September 2000, RAAM completed 13,081 fertilizer applications over 119 days. This equates to treating 17% of the County's trees once, or treating approximately 8% of the trees twice during the year. The estimated cost per fertilizer application, including an accompanying water application, is $9.14. However, the number of applications completed in FY 1999-00 may be understated in the maintenance log as RAAM records show the Division purchased fertilizer for approximately 26,000 applications. At this rate the cost per application (including watering) decreases to $5.92.

The total estimated tree maintenance cost in FY 1999-00 under the current program is $174,783[6] (Table 2) including $45,332 for watering, $91,469 for fertilization and $37,982 for resetting, removal and miscellaneous maintenance.

Alternate Tree Health Programs

Assuming all 80,000 trees require maintenance, under the current Program RAAM cannot provide an adequate level of service. Consequently, OPI estimated the total program costs for 80,000 trees and also evaluated performance levels and costs for a RAAM proposed program and for a program developed from acceptable industry practices.

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[3] Trees that have been reset require frequent watering, similar to newly planted trees.
[4] Represents nitrogen, phosphorous and potassium content respectively.
[5] Cooperative Extension advised RAAM that palm special fertilizer is also appropriate for all other tree species.
[6] Fertilizing comprised approximately 51% of maintenance activities in FY-00, watering comprised 21%, resetting and removal comprised 20%, while mulching, pruning and unrecorded activity comprised 8%.

Table 2
Tree Health Program Costs
FY 1999-00

WATERING	
Automobile Equipment Operators	$15,259
Public Works Supervisor	1,611
Administrative O/H (14.86%)	2,507
General O/H (20.37%)	3,436
Fleet Maintenance Charge	1,531
Safety Equipment/Tools	336
Water Truck (Replacement Charge)	20,652
Total	**$45,332**
Number of Water Applications	18,854
Cost Per Water Application	$2.40
FERTILIZATION	
Automobile Equipment Operators	$37,057
Public Works Supervisor	3,913
Administrative O/H (14.86%)	6,088
General O/H (20.37%)	8,346
Fleet Maintenance Charge	9,823
Fertilizer	19,800
Safety Equipment/Tools	816
Pickup Trucks - Annual Replacement Cost	5,626
Total	**$91,469**
Number of Fertilizer Applications	13,567
Cost Per Fertilizer Application	$6.74
Total Water and Fertilization Cost	**$136,801**
Cost Per Fertilizer Application With Water Application	$9.15
RESETTING/REMOVAL/MISC. COSTS	
Automobile Equipment Operators	$20,708
Public Works Supervisor	2,225
Administrative O/H (14.86%)	3,408
General O/H (20.37%)	4,672
Fleet Maintenance Charge	4,141
Safety Equipment/Tools	456
Pickup Trucks - Annual Replacement Cost	2,372
Resetting/Removal/Miscellaneous Work	**$37,982**
TOTAL PROGRAM COST	**$174,782**

Notes: Amounts for fleet maintenance charges and fertilizer are prorated based on the use of the resource for each activity.

Generally, fertilization and watering activity are dictated by season; therefore, tree maintenance programs should concentrate on fertilization during the growing season and on watering during the dry season (Table 3). However, because the growing season overlaps the dry season during March through May, RAMM should concentrate on fertilization during this period while ensuring each fertilizer application is accompanied by a watering.

Comprehensive Tree Health Program

This program assumes all 80,000 trees require routine maintenance; each tree is fertilized twice and watered 12 times per year. To minimize costs, fertilization would be year-round and would require a staff of 42 field operators and at least three field supervisors. Such a

comprehensive program also requires about 32 water trucks or rental of enough capacity to adequately water trees twice per month. Additionally, the County would need to increase the number of pickup trucks, safety equipment and tools. Eight operators would apply fertilizer, 32 would water trees while 2 operators would reset and remove trees from October through May. Twenty-eight employees would perform other, as yet unidentified, maintenance activities from June through September (the rainy season) when the requirements for watering is minimal. Performance under the comprehensive program is shown in Table 3. Overall, the program will cost an estimated $3.51 per fertilizer application and $1.84 per water application for a total annual cost of $2,957,209 (Table 4).

RAAM Proposed Tree Health Program

The Division proposes purchasing two additional water trucks and operating with a staff of 10 automotive equipment operators and one full time supervisor (Table 3). Trees would be fertilized semi-annually and as needed in response to specific circumstances, and watered once after each fertilizer application. Fertilization would be on a year-round basis using slow release, "palm special" fertilizer. RAAM would also endeavor to provide ten additional water applications per tree during the dry season from October through May. From June to September, eight automotive equipment operators would perform these tasks in teams of four; three employees in each team would fertilize, while the fourth completes the required watering after each fertilizer application. From October to May, eight employees would work in four teams of two: one to apply fertilizer while the other waters. Two automotive equipment operators would be assigned all year to reset and remove damaged or dead trees.

At this staffing level, RAAM could fertilize 50,400 (63%) of the County's trees, twice per year, with one watering for most fertilizer applications, assuming rainfall compensates for the decreased level of watering during the rainy season. RAAM could also provide an additional 57,600 water applications during the dry season, equivalent to watering only 72% of the 80,000 trees once. For this level of service, the total estimated program cost is $809,204 per year at $4.03 per fertilizer application and $1.84 per water application (Table 4).

Alternative Tree Health Program

Cooperative Extension recommends fertilization only during the warmer months (March to September). Each tree should be watered after each application, and an additional ten times during the dry season from October to May. Although RAAM proposes to use slow-release fertilizer year-round, Cooperative Extension does not recommend fertilizing during the colder months, December and January. Under this program RAAM would fertilize during the warmer months to optimize the effectiveness of fertilization and to achieve a greater balance between fertilizing and watering activity.

Under this program, using the Division's proposed staffing, work routines would vary throughout the year (Table 3). RAAM could fertilize 37,800 (47%) of the trees, twice per year, and provide an additional 82,800 water applications during the dry season (equivalent to watering each tree once). The total estimated program cost is $794,885 per year at $3.89 per fertilizer application and $1.84 per water application.

Table 3
Service Levels for Alternate Tree Health Programs

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Growing season													
Rainy season													
Dry season													

Comprehensive Tree Health Program – Routine Maintenance of 80,000 trees

Staff for fertilization	8	8	8	8	8	8	8	8	8	8	8	8	
Staff watering	32	32	32	32	32	4	4	4	4	32	32	32	
Staff for misc. work	2	2	2	2	2	30	30	30	30	2	2	2	
# of trees fertilized	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	172,800
# of trees watered	115,200	115,200	115,200	115,200	115,200	14,400	14,400	14,400	14,400	115,200	115,200	115,200	979,200

RAAM Proposed Tree Health Program[1]

Staff for fertilization	4	4	4	4	4	6	6	6	6	4	4	4	
Staff watering	4	4	4	4	4	2	2	2	2	4	4	4	
Staff for misc. work	2	2	2	2	2	2	2	2	2	2	2	2	
# of trees fertilized	7,200	7,200	7,200	7,200	7,200	10,800	10,800	10,800	10,800	7,200	7,200	7,200	100,800
# of trees watered	14,400	14,400	14,400	14,400	14,400	7,200	7,200	7,200	7,200	14,400	14,400	14,400	144,000

Program Based on University of Florida Cooperative Extension Services Recommendations[2]

Staff for fertilization	0	4	6	6	6	6	6	6	6	4	4	0	
Staff watering	4	4	4	4	4	2	2	2	2	4	4	4	
Staff for misc. work	6	2	0	0	0	2	2	2	2	6	2	6	
# of trees fertilized		7,200	10,800	10,800	10,800	10,800	10,800	10,800	10,800	7,200	7,200		97,200
# of trees watered	14,400	14,400	14,400	14,400	14,400	7,200	7,200	7,200	7,200	14,400	14,400	14,400	144,000

Program Summaries	**Comprehensive Program**	**RAAM Proposed Program**	**Program Based on Accepted Practices**
# of trees fertilized (twice /year)	**86,400**	**50,400**	**48,600**
# of water applications with fertilizer	**172,800**	**144,000**	**144,000**
# of dry season water applications[3]	**806,400**	**57,600**	**61,200**

Notes
1. Program assumes a staff of 10 for watering and fertilization
2. Assumes same staff as the RAAM proposal with no fertilization during the colder months (January and December)
3. Water applications during the dry season and that do not accompany a fertilizer application

Private Proposals

OPI examined price quotes provided to RAAM by private landscaping firms. Private sector prices are not precisely comparable to the County's estimated costs, since quantities of fertilizer and water to be applied, as well as frequency of applications, differ. Additionally, vendors made no provision for setting or removal of dead trees or watering during the dry season. OPI also found that for competitive reasons, private providers are hesitant to provide more detailed quotations.

The first firm proposed $6.57 per tree, per fertilizer application, using half as much fertilizer and one third as much water as RAAM. No price was offered for watering during the dry season. A second firm quoted $20 per tree for fertilization and a single watering but neglected to specify if the cost was for each application or for two applications per year. Again, watering costs were not provided. The third quote was verbal at $10 per tree, per fertilizer application with an accompanying watering and declined to quote a price for dry season watering.

Table 4
Cost Comparisons for Expanded Tree Health Programs

	Comprehensive Program	RAAM Proposal	Proposed Program Using Accepted Practices
FERTILIZATION			
Automobile Equipment Operators	$231,948	$143,440	$137,336
Public Works Supervisor	34,983	28,846	27,619
Administrative O/H (14.86%)	39,666	25,602	24,512
General O/H (20.37%)	54,374	35,095	33,601
Fleet/Maintenance Charges	59,837	52,261	50,037
Fertilizer	137,459	80,184	65,866
Safety Equipment/Tools	6,840	4,136	3,960
Pickup Trucks – (Annual replacement cost)	34,271	29,932	28,658
Computers/Digital Cameras	6,792	6662	6,378
Total	**$606,171**	**$406,157**	**$377,967**
Number of Fertilizer Applications	**172,800**	**100,800**	**97,200**
Cost Per Fertilizer Application	**$ 3.51**	**$4.03**	**$3.89**
WATER APPLICATION			
Automobile Equipment Operators	$659,221	$100,713	$100,713
Public Works Supervisor	99,427	20,254	20,254
Administrative O/H (14.86%)	112,735	17,976	17,976
General O/H (20.37%)	154,537	24,641	24,641
Fleet/Maintenance Charges	60,310	8,429	8,429
Safety Equipment/Tools	19,440	2,904	2,904
Water Meter Rental	6,528	816	816
Water Trucks	660,853	82,607	82,607
Pickup Truck (Supervision)	6478	1320	1,320
Computers/Digital Cameras	19304	4667	4,677
Total	**$1,798,831**	**$264,336**	**$264,336**
Number of Water Applications	979,200	144,000	144,000
Cost Per Application	$1.84	$1.84	$1.84
Total Water and Fertilization Cost	**$2,405,002**	**$670,492**	**$642,303**
RESETTING / REMOVAL AND MISCELLANEOUS COSTS			
Automobile Equipment Operators	$329,610	$ 61,038	$67,142
Public Works Supervisor	49,713	12,275	$13,502
Administrative O/H (14.86%)	56,368	10,894	11,984
General O/H (20.37%)	77,268	$14,934	16,427
Fleet/Maintenance Charges	12,638	22,239	24,463
Safety Equipment/Tools	9,720	1,760	1,936
Pickup Trucks	7,238	12,737	14,011
Computers/Digital Cameras	9652	2835	3,118
Total	**$552,207**	**$138,712**	**$152,583**
Total Program Cost	**$2,957,209**	**$809,204**	**$794,885**

In addition to the contractor costs for fertilization, the County would incur tree setting and removal costs, costs for watering during the dry season and additional costs for managing the tree maintenance contracts. OPI estimates it could cost between $132,000 and $263,000 per year ($0.82 per tree for one contract manager and $3.28 per tree for three contract managers) to supervise work and manage these contracts countywide.

Survey Results
OPI examined tree maintenance practices in six jurisdictions, including the County's Park and Recreation Department. Results are summarized in Attachment I. Palm Beach County and the City of Aventura both outsource tree maintenance as part of comprehensive landscape maintenance contracts. However, OPI was unable to obtain actual contract costs. Palm Beach County manages multiple contracts, assigned by region, for its 4,000 trees, while Aventura uses a single contractor. In Aventura, most rights-of-way have irrigation systems; therefore, watering is not included in the tree maintenance contract however, contracts include stringent measures for supervision by City officials. Palm Beach County contracts do not include a high level of contract monitoring, and officials acknowledge that contractors often fall behind in their work. Of all jurisdictions contacted, the City of Coral Gables maintains the highest number of trees (34,000) and does not employ outside contractors for tree maintenance. In Broward County, adjacent property owners are responsible for tree maintenance, at no cost to the County. Consequently, the jurisdiction maintains only approximately 519 trees.

CONCLUSIONS AND RECOMMENDATIONS

A review of private provider cost estimates demonstrates that the County can competitively maintain (water, fertilize, remove and reset) trees in the rights of way. Based on the current maintenance policy, it is apparent that the resources are inadequate for maintaining all 80,000 trees and that more funding would be required for a complete Tree Health Program. However, until better information is available OPI recommends limiting staff increases to 10 and water truck purchases to two.. Due to large gaps in the Division records, RAAM's productivity and workload should be assessed to make a final determination on the optimum staffing and equipment requirements and assess if private providers should also assist with tree maintenance. OPI therefore recommends the interim increase, and using additional temporary help where feasible, until the optimum staffing and equipment resources can be determined.

Additionally, OPI recommends the following:

- To accurately determine the tree health workload, RAAM should complete the inventory of all trees Countywide, noting the species, location, and general environmental conditions. This may be achieved through temporary help or a summer intern program.
- Using the University of Florida's Cooperative Extension and other resources for reference, RAAM should determine the number and location of trees that require

prescriptive maintenance only. Many species planted in hospitable areas may be considered established (thus requiring limited maintenance) three years after planting.

- The remaining trees should comprise the normal maintenance workload from which to create a comprehensive maintenance program. These should include trees planted in medians, those prone to disease, and several palm species (including royal and sabal palms) that require permanent care irrespective of age or location. This will allow RAMM to concentrate on those trees requiring the highest level of maintenance while avoiding the cost of unnecessary treatments.

- RAAM should divide the County into zones based on tree load and assign work teams with full responsibility for each zone and for maintaining detailed work logs.

- Where peak demand and extenuating circumstances dictate, RAAM should hire temporary help and/or rent additional equipment for fertilization, watering, resetting and removal as needed.

- RAAM's productivity and workload should be measured and target performance levels established before hiring new permanent staff. This information will determine the actual staff and equipment needed to adequately maintain trees.

OPI research indicates the County could incur additional tree health costs when some species not indigenous to South Florida are planted. These species normally require additional care and maintenance. For future tree plantings (new and replacement trees) these factors should be considered when selecting species for planting along rights-of-way. While visual impact and aesthetics are important, the County should evaluate the costs and levels of maintenance, susceptibility to pests and disease, the aggressive nature of root systems[7], and tree cost. For example, palms that are susceptible to lethal yellowing, including most varieties of the coconut palm as well as the Christmas and Canary Island date palms, are not recommended. Cooperative Extension maintains a list of recommended palms and ornamental trees for South Florida, including information regarding adaptability to dry soil conditions, suitability for roadside use, and salt tolerance.

Given the large volumes involved, the County may wish to consider alternative tree health strategies including requiring property owners to maintain trees on their easements, "adopt-a-tree" or "adopt-a-median" programs[8]. These initiatives may be undertaken in conjunction with the "Shade for Dade" program coordinated by the Department of Environmental Resources Management or may be supported through future County corporate sponsorship initiatives.

Although RAAM would be able to fertilize a greater number of trees under its proposed year-round program, fertilizer applied during the colder months would be largely ineffective. In theory, slow-release fertilizer can remain on the ground until activated by water; however, in

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[7] During Hurricane Andrew, many shade trees with shallow, widespread roots were uprooted causing significant damage to surrounding land. The County has planted more palms than shade trees along rights-of-way because root systems of palms are less aggressive.

[8] The City of Cape Canaveral and Brevard and Flagler Counties instituted Adopt-a-median programs.

practice, RAAM proposes to water extensively during the dry season. Consequently, it is recommended that RAAM also rethink the practice of fertilizing in December and January.

Attachment

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Attachment I
Tree Health Program
Survey of Selected South Florida Jurisdictions

Jurisdiction	Fertilization	Watering	Comments
Miami-Dade County Department of Public Works Right-of-Way Aesthetic and Assets Management (RAAM) Division	Preferred level of service: Applied twice per year to each tree using 5 lbs of slow release, palm special fertilizer per application. Fertilization is year-round (as opposed to seasonally). RAAM is responsible for approximately 80,000 trees. Current level of service: According to logbook data, RAAM provided 13,567 applications during fiscal year 1999-2000. According to the quantity of fertilizer purchased, the actual number of applications may be closer to 26,000.	Preferred level of service: One application for each fertilizer application. Ten additional applications per year during the dry season (October-May) or as needed for new plantings, special fertilizer applications, vehicular knockdowns, and/or weather damage. Approximately 20-30 gallons of water per application. Current level of service: RAAM provided 18,854 applications during fiscal year 1999-2000.	
Miami-Dade County Park and Recreation (Parks) Department	Parks does not usually fertilize mature trees, except for royal and foxtail palms. Program specifics vary across the County and are determined by regional operations managers.	Generally, Parks does not water mature trees. Some parks have irrigation systems and some have hose bibs that can be used for hand watering at the discretion of Parks staff.	Parks trees are much less susceptible to drought than trees in the rights-of-way, due to more hospitable soil conditions and less heat generated from pavement, vehicle exhaust, etc.
City of North Miami Beach Public Works Department Beautification Division	Fertilizer applied to palms only. Three applications of magnesium and manganese per year during the rainy season (May-Sept.)—approximately 10 lbs. of fertilizer per tree, per year. The Division estimates the cost of fertilizer at $4, per tree, per year.	Division does not water mature trees.	The Beautification Division has an annual budget of $50,000 and maintains approximately 300-350 trees in addition to all urban forest and landscaped areas. One employee does all maintenance work.
Broward County	The Department of Planning and Environmental Protection Biological Resources Division recommends that palms be fertilized at least three times per year.	n/a	By ordinance, Broward property owners are responsible for maintaining trees in adjacent rights-of-way. The County does not maintain a count of how many trees are maintained by property owners. The Streets and Highway Division of the Public Works Department prunes about 519 trees along County rights-of- way.
City of Coral Gables Public Works Department Public Service Division	The division fertilizes new plantings and mature palms only. A crew of two employees, who also apply pesticides and herbicides to turf and other plants, does the fertilizing as needed.	The division has two water trucks and a crew of two vehicle operators. Watering is the division's top maintenance priority and trees are watered as often as resources permit. Young trees, especially those planted along medians with restricted soil space, are given first priority. The division also waters older trees during droughts.	The division maintains approximately 34,000 trees Citywide, primarily on rights-of-way but also within City parks. Tree trimming and pruning are contracted out, but watering and fertilizing are done in-house. The division prefers to maintain these functions in-house for greater flexibility, ability to make judgment calls about the required level of service, and ease of supervision

Attachment I
Tree Health Program
Survey of Selected South Florida Jurisdictions

Jurisdiction	Fertilization	Watering	Comments
Palm Beach County Public Works Department	The County has several contractors providing comprehensive landscaping services by geographic area. Fertilizing is included as part of the total package. Trees are fertilized twice per year between March and October, no more than 4 months apart. Contractors are required to use 1 pound of fertilizer per 1 inch of trunk diameter. Fertilizer composition depends on the tree species; palms are fertilized using blends including minor elements, very high sulfur, manganese, magnesium, iron, 50% slow release nitrogen and potassium, and acid based or approved equal.	Palm Beach has a tree installation contract that also includes watering; the hourly rate is $75. The contractor is to apply a minimum of 15 gallons of water per application, at a maximum rate of 4 gallons per minute. According to the contract, established trees should be watered twice a month during the dry season. The contractor is supposed to provide a record of all watering, however, he often falls behind. The Division does visually inspect trees but does not closely supervise the contractor.	The "Trees Only" program was instituted in order to introduce diverse species of trees to County rights-of-way. The Division maintains approximately 4,000 trees along rights-of-way. Tree maintenance is contracted out according to area.
City of Aventura Department of Public Works	One contractor provides comprehensive right-of-way maintenance services to the City. According to the terms of the contract, palms (other than date palms) are to be fertilized four times per year at quarterly intervals, including two applications of liquid 16-4-8 and two applications of granular 13-3-13. Date palms are fertilized four times per year in February, May, August and November, with 10 pounds of 12-6-8 fertilizer per palm, per application. Additionally, the contractor treats date palms three times per year with fungicide. The unit price for comprehensive maintenance of date palms is $120 per tree, per year. Other trees are fertilized three times per year with granular fertilizer.	Most rights-of-way in Aventura are watered by irrigation systems. The contract rate for a 500-gallon capacity water tank is $150 per day.	All chemical applications require written approval by the City prior to application. The contractor is required to notify the City in advance of fertilizer and fungicide applications to allow for inspection by City officials. The contractor is required to notify the City by 9:00 a.m. of the following workday regarding other maintenance work completed. The City inspects the maintenance area within 24 hours.